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Reply under 37 CFR 1.116  
- Expedited Procedure -  
Examining Group 2823

PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of:

Sailesh Merchant, et al.

Serial No.: 09/092,158

Filed: June 6, 1998

For: METHOD FOR THE FABRICATION OF CONTACTS IN AN  
INTEGRATED CIRCUIT DEVICE

Group No.: 2823

Examiner: Eaton, K.

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Sir:

**REQUEST FOR CONSIDERATION UNDER 37 C.F.R. § 1.116**

In response to the Examiner's Action mailed June 6, 2000, please reconsider the above-mentioned application in view of the following remarks:

The Applicants originally submitted Claims 1-23 in the application. In a previous Official Action the Applicants added Claim 24 and canceled Claims 3 and 13. Accordingly, Claims 1-2, 4-12 and 14-24 are currently pending in the application.

**I. Rejection of Claims 1,2, 4-12 and 14-24 under 35 U.S.C. §103**

The Examiner has rejected Claims 1, 2, 4-12 and 14-24 under 35 U.S.C. §103(a) as being unpatentable over the Applicants admitted prior art in view of U.S. Patent No. 5,827,777 to Schinella, et al. (Schinella) and U.S. Patent No. 5,462,895 to Chen (Chen). As the Examiner is no doubt aware, determination of obviousness requires consideration of the invention considered as a whole; the inquiry is not whether each element exists in the prior art, but whether the prior art made obvious the invention as a whole. Furthermore, there must be some suggestion or teaching in the art that would motivate one of ordinary skill in the art to arrive at the claimed invention; *a reference that teaches away from a claimed invention strongly indicates nonobviousness*. The Applicants respectfully submit that the references relied on by the Examiner are improperly combined, and therefore fail to establish a prima facie case of obviousness with respect to the present invention. The presently claimed inventions, specifically Claims 1,12 and 24, are directed to a method of improving the quality of the barrier layer by depositing the barrier layer with a *physical vapor deposition* process and annealing the barrier layer after the contact plug is formed.

Contrary to the present invention, the admitted prior art teaches depositing a barrier layer (114 & 116) within a contact opening (110) using a *physical vapor deposition* process, performing a rapid thermal anneal after formation of the barrier layer (114 & 116), followed by a deposition of a tungsten plug. As the Examiner correctly asserts on page 4 of the Examiner's Action dated December 28, 1999, the admitted prior art "does not show (i.e., teach or suggest) depositing the contact metal immediately after deposition of the barrier layer and prior to the anneal step claimed in the present invention," as recited in independent Claims 1, 12 and 24.

Schinella is directed to a process for producing a relatively thin titanium nitride (TiN) barrier layer in a contact opening of an integrated circuit. Schinella recognizes the problems associated with the use of tungsten hexafluoride and its effect on the TiN layer within a contact structure. (Col. 3, lines 12-29). As noted by the Examiner, Schinella also does not teach or suggest a step that anneal the Ti/TiN layer after the contact plug formation, as recited in independent Claims 1, 12 and 24. Schinella, not teaching or suggesting a step of annealing the device after contact plug formation is not surprising, since Schinella addresses the problem by depositing a very thin TiN layer. -same thickness as APA

In contrast to the present Application and the admitted prior art, Chen is directed to a *chemical vapor deposition* process of forming an adhesive layer for a blanket layer that includes a Ti film, a Ti-rich TiN film, a titanium silicide (TiSi<sub>x</sub>) film or a TiN (stoichiometric) film within a contact opening. Contrary to the present invention and the admitted prior art, Chen teaches using a *chemical vapor deposition* process and specifically teaches away from using a *physical vapor deposition* process. Chen teaches that using a *physical vapor deposition* process to form the Ti/TiN "has a shortcoming, in that the reactive TiN film or its underlying Ti layer has a poor step

coverage, and Ti and TiN therefore are difficult to deposit inside the contact hole." Chen further teaches that the poor step coverage "leads to an increase in the resistance of the contact resistance and diffusion of tungsten into the Si substrate during the annealing, an increase of the leakage current, and decreases the control of the thicknesses of the Ti and TiN layers inside the contact hole." (Column 1, lines 37-46) Thus, Chen expressly teaches away from depositing the Ti or TiN layers using a *physical vapor deposition* process. As such, one skilled in the art would not be motivated to combine the *physical vapor deposition* process of the admitted prior art and the *chemical vapor deposition* process required by Chen, given Chen's specific teaching away from using a *physical vapor deposition* process. Therefore, the combination of Chen and the admitted prior art is improper.

Ex.  
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CVD  
process  
of Chen

Neither the admitted prior art nor the Schinella reference teaches or suggests, as the Examiner correctly points out, depositing the contact metal immediately after deposition of the barrier layer and prior to the anneal step claimed in the present invention. Similarly, the only reference that teaches annealing the device after depositing the contact metal (Chen), also teaches away from using a *physical vapor deposition* process for forming the barrier layer. Therefore, given that Chen is not properly combined with the admitted prior art, the combination of the admitted prior art and Schinella fails to teach or suggest every element independent Claims 1, 12 and 24.

Thus, the references in combination fail to establish a prima facie case of obviousness with respect to Claims 1, 12 and 24, because they are either improperly combined or when combined fail to teach or suggest each element of Claims 1, 12 and 24. In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 1-2, 4-12 and 14-

24 under 35 U.S.C. §103(a). The Applicant therefore respectfully request the Examiner withdraw the rejection.

## II. Conclusion

In view of the foregoing remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a Notice of Allowance for Claims 1-2, 4-12 and 14-24.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application.

Respectfully submitted,

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Dated: 8/15/2000

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